

Research on Growth Evaluation of Sci-Tech Innovation Board Listed Companies Based on Factor Analysis

Chongming Liu^{1,a}, Yingjie Teng^{1,b,*}

¹ School of Economics and Management, North China Electric Power University, No.2 Beinong Road, Huilongguan, Changping District, Beijing, China
a. 13601223799@163.com, b. universe_sun51@163.com

*corresponding author

Keywords: sci-tech innovation board listed companies, growth evaluation, factor analysis method

Abstract: The growth of Sci-Tech Innovation Board listed companies directly affects the sustainable development of the board. It is obviously incomplete to evaluate the growth only from internal financial factors. The non-financial factors outside the company are more important. This article constructs a comprehensive growth evaluation index system including financial and non-financial indicators. They are policy support, industry development potential, market prospects, technology and innovation, financing capacity, and earnings growth potential. The first 25 listed companies on Sci-Tech Innovation Board were used as samples. Empirical analysis was performed on sample data by factor analysis, and comprehensive factors affecting growth were extracted. Finally, the growth of Sci-Tech Innovation Board listed companies was scored and ranked.

1. Introduction

Growth of enterprise is not only the foundation of company's profit model, but also the guarantee of company's sustainable development. At present, scholars have little research on the growth of listed companies on Sci-Tech Innovation Board, and most of research is based on financial perspective. In the listing conditions of Sci-Tech Innovation Board, there are no hard-and-fast rules for profitability. Therefore, it is inaccurate to evaluate the growth of the companies listed on Sci-Tech Innovation Board only from financial perspective. This article puts more emphasis on non-financial factors, particularly on national strategy and policy support, industry technology prospects, and future market demand. As for internal financial factors, this paper uses sales growth, profitability growth, financing expansion and financial flexibility. In this paper, factor analysis method is used to evaluate the company's growth. And the result of empirical research is hoped to give stakeholders the inspiration of investment, management, supervision and other aspects.

2. Relevant Literature Review

Scholars' research on growth mainly focuses on influencing factors and growth evaluation.

In terms of influencing factors of growth, David Tomczyk and others[1] determined that the entrepreneurs' values and the total benefits offered are instrumental to firm performance. Bin Jiancheng and Chen Liuqin[2] believed that it is necessary to strengthen government policy support for Chinese high-tech industries. Yu Meifei and Chen Jing[3] discussed the impact of venture capital on corporate growth. The result showed that the involvement of venture capital can promote the growth of SME companies.

In terms of growth evaluation research, Park and Jang[4] used factor analysis to study the international development of catering companies and found that the scale of the company is proportional to growth rate. Lv Qinghua and Gong Shijie[5] evaluated the growth of 19 listed sporting goods companies in China from environment, resources and growth capacity. Liu Chao and Hu Guihui[6] constructed an indicator system from profitability, scale and development ability to evaluate the growth of 21 feed listed companies.

In summary, scholars evaluate the growth mainly from internal factors or certain individual factors. This article establishes an internal and external factor system and uses the factor analysis method to evaluate the company's growth. The result is hoped to enlighten stakeholders on investment, management, and supervision.

3. Research Design

3.1. Selection of Factors and Indicators

To build a complete and comprehensive index system to evaluate the growth effectively, the selection of evaluation indicators should be based on the principles of science, comprehensiveness, comparability and measurability.

3.1.1. Policy Support

The listed companies on Sci-Tech Innovation Board were born in compliance with the national development strategy and supported by national policies. This paper uses 6 aspects as policy support indicators, which refers to the views of Bin Jiancheng and Chen Liuqin[2].

3.1.2. Industry Development Potential

The company's industry has greatly affected the company's growth. This article selects two indicators: the overall size of the industry and the industry growth rate to evaluate the industry development potential of the listed company on Sci-Tech Innovation Board.

3.1.3. Market Prospects

If the company's products do not meet market demand, the company's growth will be seriously affected. Therefore, relative market share and sales growth rate are important to measure the company's market prospects.

3.1.4. Technology and Innovation

Sci-Tech Innovation Board listed companies are committed to researching and developing world-class technologies and products. The evaluation of their growth is inseparable from the assessment of technology and innovation. This article assesses the technological innovation level from three aspects: technology investment, technology uniqueness, and R&D personnel ratio.

3.1.5. Financing Capacity

Financing capacity is a key factor for a company's high growth. Whether the listed companies of Sci-Tech Innovation Board can have high growth depends largely on the company's financing ability. The evaluation of financing capacity in this paper is mainly reflected through financing efficiency and financing potential.

3.1.6. Earnings Growth Potential

The growth of the company is ultimately reflected in the level of profitability. There are no hard-and-fast regulations on the level of profitability in the listing conditions of Sci-Tech Innovation Board, so the current low-profitability company does not mean that its future growth is low. This article evaluates the financial potential from the operating income growth rate and net profit growth rate.

This paper finally selects 17 indicators from six perspectives: policy support, industry development potential, market prospects, technology and innovation, financing capacity and earnings growth potential to evaluate the growth of listed companies on Sci-Tech Innovation Board. The index system is shown in Table 1.

Table 1: Index System for Growth Evaluation of Listed Companies on Sci-Tech Innovation Board.

Evaluation dimension	Evaluation index	Remarks
Policy Support	Tax Incentives	Score according to the level of support, with a maximum of 5 points and a minimum of 1 point
	Financial Support	Same as above
	Banking Support Systems	Same as above
	Intellectual Property Protection	Same as above
	Talent Development Introduction and Incentives	Same as above
	International Trade	Same as above
Industry Development Potential	Overall Size of the Industry	Measured by total industry output value
	Industry Growth Rate	Industry added value/last year industry output value*100%
Market Prospects	Relative Market Share	The company's sales revenue / the largest competitor's sales revenue during the period * 100%
	Sales Growth Rate	The company's sales revenue / the company's sales revenue in the previous period * 100%
Technology and Innovation	Technology Investment	Measured by the R&D expense ratio, the formula is R&D expenses for the period/Operating income for the period*100%
	Technology Uniqueness	Measured by the cumulative number of intellectual property acquired by the company
	R&D Personnel Ratio	The number of the company's R & D personnel / total number of employees * 100%
Financing Capacity	Financing Efficiency	Measured by the size of assets, taking the natural logarithm of the book value of assets
	Financing Potential	Use the asset-liability ratio to reflect the capital structure, the formula is debt/asset *100%
Earnings Growth Potential	Operating Income Growth Rate	(Operating income in the current period-Operating income in the previous period)/Operating income in the previous period*100%

	Net Profit Growth Rate	(Net profit for the current period-net profit for the previous period)/net profit for the previous period*100%
--	------------------------	----------------------------------------------------------------------------------------------------------------

3.2. Sample Data and Evaluation Method

According to the data in the annual report of the listed companies and the National Bureau of Statistics, the first 25 companies listed on Sci-Tech Innovation Board are selected as samples. The factor analysis method is used to find the main factors, so as to comprehensively evaluate the growth. The statistical software SPSS22.0 is used to analyse the data and the results are summarized by Excel.

It is necessary to perform a proper index positive treatment on the asset-liability ratio index, because only asset-liability ratio index is not positive among all indicators. The method proposed by Ye Zongyu[7] is used here. In addition, due to the different units of measurement of different indicators, Z-score normalization was performed on the data. The following analysis is carried out on this basis.

4. Empirical Research on Factor Analysis

4.1. Feasibility Test

Before conducting the analysis, it is necessary to test whether the variables are suitable for factor analysis. Usually, KMO and Bartlett's test of sphericity are used. It can be seen from Table 2 that the statistics of Bartlett sphericity test is 456.775. The corresponding probability p is 0.000, which is far less than the significance level of 0.05. It can be considered that there is a significant difference between the correlation coefficient matrix and the identity matrix. The value of KMO is 0.508, indicating that each variable has a strong correlation and is suitable for factor analysis.

Table 2: KMO and Bartlett's Test.

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.508
Bartlett's Test of Sphericity	Approx. Chi-Square	456.775
	df	136
	Sig.	.000

4.2. Factor Extraction

The results reflecting factor extraction and rotation are shown in Table 3.

Table 3: Total Variance Explained.

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.597	32.923	32.923	5.597	32.923	32.923	4.769	28.051	28.051
2	3.004	17.673	50.596	3.004	17.673	50.596	2.687	15.806	43.857

3	2.101	12.361	62.957	2.101	12.361	62.957	2.361	13.889	57.746
4	1.330	7.821	70.779	1.330	7.821	70.779	1.821	10.713	68.459
5	1.244	7.320	78.099	1.244	7.320	78.099	1.407	8.276	76.735
6	1.130	6.650	84.748	1.130	6.650	84.748	1.362	8.014	84.748
7	.796	4.684	89.432						
8	.565	3.325	92.757						
9	.421	2.475	95.232						
10	.324	1.904	97.136						
11	.208	1.224	98.361						
12	.159	.937	99.298						
13	.066	.385	99.683						
14	.030	.177	99.861						
15	.015	.088	99.948						
16	.009	.051	99.999						
17	.000	.001	100.000						

Extraction Method: Principal Component Analysis.

After processing all the variable index data with SPSS22.0, the initial component matrix is obtained. In order to distinguish the relationship between each index and the factor more easily, the initial factor matrix is carried out according to the Kaiser standardized maximum variance method. The rotated component matrix is shown in Table 4.

Table 4: Rotated Component Matrix^a.

	Component					
	1	2	3	4	5	6
X1:tax incentives	.760	.205	.129	-.473	-.073	.006
X2:financial support	.009	-.131	-.093	-.074	.069	.889
X3:banking support systems	.879	.135	.150	-.258	.273	-.062
X4:intellectual property protection	.405	.871	-.044	.128	.034	.004
X5:talent development introduction and incentives	.857	.335	.105	.096	.244	.010
X6:international trade	.844	.306	.188	-.127	.280	.060
X7:overall size of the industry	-.016	-.130	.045	.251	-.782	-.110
X8:industry growth rate	.773	-.163	.210	.157	-.014	-.298
X9:relative market share	.181	-.134	-.134	.392	.610	-.026
X10:sales growth rate	.164	-.102	.938	-.048	-.116	-.125
X11:technology investment	.660	.023	.052	.476	-.180	.347
X12:technology uniqueness	.015	.926	-.023	-.215	.025	-.006
X13:R&D personnel ratio	.813	-.065	.009	.153	-.321	.308
X14:financing efficiency	.050	.757	-.049	-.390	.016	-.145
X15:financing potential	-.078	-.278	-.009	.882	-.067	-.101

X16:operating income growth rate	.153	-.105	.937	-.051	-.119	-.128
X17:net profit growth rate	.157	.221	.662	.107	.174	.430

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 7 iterations.

According to the rotated composition matrix, the first main factor has a high load on X1 tax incentives, X3 financial support system, X5 talent development introduction and incentives, X6 international trade, X8 industry growth rate, X11 technology investment, X13 R&D personnel ratio. It mainly reflects the macro-environmental support and technical input, so it is recorded as environmental and technical factor.

The second main factor has a high load on X4 intellectual property protection, X12 technology uniqueness, and X14 financing efficiency. It mainly reflects technical reserves and expansion capabilities, so it is recorded as development reserve factor.

The third main factor has a higher load on the X10 sales growth rate, X16 operating income growth rate, and X17 net profit growth rate. It mainly reflects the operating quality and operating efficiency and is recorded as financial factor.

The fourth main factor has a higher load on the X15 financing potential. It mainly reflects the anti-risk ability and financing potential and is recorded as the financing potential factor.

The fifth main factor has a higher load on the X7 overall size of the industry and the X9 relative market share. It mainly reflects the development and market competitiveness of the industry in which the enterprise is located and is recorded as the competition factor.

The sixth main factor has a higher load on X2 financial support. It mainly reflects the government financial support and is recorded as the financial support factor.

4.3. Factor Score Expression

The component score coefficient matrix shown in Table 5 calculates the factor score of each main factor according to the factor score coefficient:

Table 5: Component Score Coefficient Matrix.

	Component					
	1	2	3	4	5	6
X1:tax incentives	.198	-.081	-.054	-.309	-.129	-.012
X2:financial support	-.021	-.074	-.015	-.109	.018	.662
X3:banking support systems	.207	-.105	-.029	-.169	.147	-.089
X4:intellectual property protection	.002	.408	-.010	.252	-.050	-.009
X5:talent development introduction and incentives	.159	.077	-.015	.104	.126	-.042
X6:international trade	.157	.018	.018	-.044	.148	.005
X7:overall size of the industry	.042	.043	-.029	.103	-.564	-.063
X8:industry growth rate	.211	-.130	-.011	.042	-.011	-.268
X9:relative market share	.025	-.049	-.032	.243	.473	-.073
X10:sales growth rate	-.046	-.019	.414	-.012	-.023	-.059
X11:technology investment	.131	.060	-.027	.262	-.160	.217

X12:technology uniqueness	-.091	.408	.032	.063	-.054	.019
X13:R&D personnel ratio	.219	-.068	-.103	.011	-.288	.191
X14:financing efficiency	-.039	.277	-.012	-.090	-.058	-.087
X15:financing potential	-.031	.068	.030	.524	.020	-.104
X16:operating income growth rate	-.048	-.020	.414	-.014	-.024	-.061
X17:net profit growth rate	-.109	.153	.353	.144	.145	.338

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization. Component Scores.

$$F1=0.198X1-0.021X2+0.207X3+0.002X4+0.159X5+0.157X6+0.042X7+0.211X8+0.025X9+0.046X10+0.131X11+0.091X12+0.219X13-0.039X14-0.031X15-0.048X16-0.109X17 \quad (1)$$

$$F2=-0.081X1-0.074X2-0.105X3+0.408X4+0.077X5+0.018X6+0.043X7-0.130X8-0.049X9-0.019X10+0.060X11+0.408X12-0.068X13+0.277X14+0.068X15-0.020X16+0.153X17 \quad (2)$$

$$F3=-0.054X1-0.015X2-0.029X3-0.010X4-0.015X5+0.018X6-0.029X7-0.011X8-0.032X9+0.414X10-0.027X11+0.032X12-0.103X13+0.012X14+0.030X15+0.414X16+0.353X17 \quad (3)$$

$$F4=-0.309X1-0.109X2-0.169X3+0.252X4+0.104X5-0.044X6+0.103X7+0.042X8+0.243X9-0.012X10+0.262X11+0.063X12+0.011X13-0.090X14+0.524X15-0.014X16+0.144X17 \quad (4)$$

$$F5=-0.129X1+0.018X2+0.147X3-0.050X4+0.126X5+0.148X6-0.564X7-0.011X8+0.473X9-0.023X10-0.160X11-0.054X12-0.288X13-0.058X14+0.020X15-0.024X16+0.145X17 \quad (5)$$

$$F6=-0.012X1+0.662X2-0.089X3-0.009X4-0.042X5+0.005X6-0.063X7-0.268X8-0.073X9-0.059X10+0.217X11+0.019X12+0.191X13-0.087X14-0.104X15-0.061X16+0.338X17 \quad (6)$$

Among them, F1 to F6 are the scores of selected sample companies on public factors, X1 to X17 represent 17 evaluation indicators. On this basis, the overall growth score of each company is calculated by taking the ratio of the variance contribution rate of each main factor and the cumulative variance contribution rate as the weight. The specific calculation formula is as follows:

$$F = (28.051F1+15.806 F2+13.889 F3+10.713 F4+8.276F5+8.014F6)/ 84.748 \quad (7)$$

Through calculations, the growth scores of the 25 companies that first listed on the Sci-Tech Innovation Board were shown in Table 6:

Table 6: Comprehensive Growth Score Ranking of Listed Company on Sci-Tech Innovation Board

Rank	Stock Code	Stock Name	Religion	Industry Category	Score
1	688088	ArcSoft	Zhejiang	Software and IT services	1.2094

2	688018	Espressif	Shanghai	Software and IT services	0.9750
3	688012	AMEC	Shanghai	Special Equipment Manufacturing Industry	0.9467
4	688009	CRSC	Beijing	Railway, Shipbuilding, Aerospace and Other Transportation Equipment Manufacturing	0.4189
5	688016	Endovastec	Shanghai	Special Equipment Manufacturing Industry	0.1881
6	688002	Yantai Raytron Technology	Shandong	Computer, Communications and Other Electronic Equipment Manufacturing	0.1460
7	688066	Piesat	Beijing	Software and IT services	0.1429
8	688019	Anjimirco	Shanghai	Computer, Communications and Other Electronic Equipment Manufacturing	0.0774
9	688029	Micro-Tech	Jiangsu	Special Equipment Manufacturing Industry	- 0.0087
10	688015	Traffic Control Technology	Beijing	Railway, Shipbuilding, Aerospace and Other Transportation Equipment Manufacturing	- 0.0767
11	688388	Jiayuan Technology	Guangdong	Computer, Communications and Other Electronic Equipment Manufacturing	- 0.0852
12	688008	Montage Technology	Shanghai	Computer, Communications and Other Electronic Equipment Manufacturing	- 0.0858
13	688333	Bright Laser Technologies	Shanxi	General Equipment Manufacturing	- 0.1057
14	688007	Appotronics	Guangdong	Computer, Communications and Other Electronic Equipment Manufacturing	- 0.1166
15	688003	Tztek	Jiangsu	Special Equipment Manufacturing Industry	- 0.1430
16	688122	Western Superconducting	Shanxi	Nonferrous Metal Smelting and Rolling Processing Industry	- 0.2249
17	688001	HYC Technology	Jiangsu	Special Equipment Manufacturing Industry	- 0.2343
18	688033	Tianyishangjia	Beijing	Railway, Shipbuilding, Aerospace and Other Transportation Equipment Manufacturing	- 0.2798
19	688022	Harmontronics	Jiangsu	Special Equipment Manufacturing Industry	- 0.2906
20	688020	Fangbang Electronics	Guangdong	Computer, Communications and Other Electronic Equipment Manufacturing	- 0.3153
21	688010	Ricom	Fujian	Instrumentation Manufacturing	- 0.3358
22	688028	Worldia	Beijing	Special Equipment Manufacturing Industry	- 0.3713
23	688005	Ronbay Technology	Zhejiang	Computer, Communications and Other Electronic Equipment Manufacturing	- 0.4476
24	688011	New Optoelectronics Technology	Heilongjiang	Computer, Communications and Other Electronic Equipment Manufacturing	- 0.4915
25	688006	Hangke Technology	Zhejiang	Special Equipment Manufacturing Industry	- 0.4916

4.4. Empirical Analysis

Among the top five companies with comprehensive growth score shown in Table 6, from the perspective of industry distribution, two companies belong to Software and IT services, two belong to the Special Equipment Manufacturing Industry, and one belongs to the Railway, Shipbuilding, Aerospace and Other Transportation Equipment Manufacturing. Considering the industry distribution of the sample companies, there are 3 companies that belong to Software and IT services, and 8 companies that belong to the Special Equipment Manufacturing Industry, 3 companies which belong to the Railway, Shipbuilding, Aerospace and Other Transportation Equipment

Manufacturing. It can be seen that companies in Software and IT services and in the Railway, Shipbuilding, Aerospace and Other Transportation Equipment Manufacturing have shown relatively high growth. From the perspective of regional distribution, one is located in Zhejiang, one in Beijing, and three in Shanghai. Among the 25 Sci-Tech Innovation Board companies, there are 5 companies respectively in Beijing and in Shanghai, and 3 companies in Zhejiang. It shows that the Sci-Tech Innovation Board companies in Shanghai and Zhejiang have high growth.

Among the last five companies in the overall growth score, from the perspective of industry distribution, 1 company belongs to the Instrumentation Manufacturing, 2 companies belong to the Computer, Communications and Other Electronic Equipment Manufacturing, and 2 belong to the Special Equipment Manufacturing Industry. Considering the industry distribution of the sample companies, there are 8 companies belonging to the Computer, Communications and Other Electronic Equipment Manufacturing. The highest ranking company is Yantai Raytron Technology located in Shandong, ranking 6th. There are 8 companies that belong to the Special Equipment Manufacturing Industry. Except for the No.3 AMEC and No.5 Endovastec, the ranking of the other Special Equipment Manufacturing Industry companies is relatively average. It can be seen that companies in the Computer, Communications and Other Electronic Equipment Manufacturing and in the Special Equipment Manufacturing Industry have shown various growth.

Overall, there are 3 outstanding growth companies with a comprehensive growth score greater than 0.5, accounting for 12% of the total sample. These companies are high-growth companies. There are 5 companies in the (0, 0.5) score range, accounting for 20% of the sample. These companies are general growth companies. There are 17 companies in the (-0.5, 0) score range, accounting for 68% of the sample. These companies still have room for growth improvement.

5. Conclusion and Prospect

The research in this paper is based on the data of the first 25 companies listed on the Sci-Tech Innovation Board. By establishing an index system that affects growth, this paper uses factor analysis to extract the main factors of 17 indicators. Finally, the paper calculates the company's comprehensive score and evaluates the growth of the companies. The result basically reflects the current growth status of the 25 listed companies on the Sci-Tech Innovation Board. Although many companies have a negative overall score, they are all in the range of greater than -0.5, and most of them are affected by certain indicators such as debt to asset ratio. It can be believed that after the listing and financing of the Sci-Tech Innovation Board, the growth of these companies will be well. At the same time, the research results also show that policy support and technological innovation are the two cornerstones of the future development of the Sci-Tech Innovation Board. To achieve long-term growth for the Sci-Tech Innovation Board, it is inseparable from the support of national development strategies, favourable policies, technological innovation and talent reserve.

This paper still has room for research on the growth of listed companies on the Sci-Tech Innovation Board. With the development of the Sci-Tech Innovation Board market, the research on the growth of these companies will be evaluated based on multi-year data, which will be completed through follow-up research.

References

- [1] Tomczyk, D. , Lee, J. , & Winslow, E. . (2013). *Entrepreneurs' Personal Values, Compensation, and High Growth Firm Performance*. *Journal of Small Business Management*, 51(1), 66-82.
- [2] Bin Jiancheng, & Chen Liuqin. (2006). *On the Construction of Policy Support System for The development of High-tech Industries in China*. *Journal of Industrial Technological Economics*, 025(001), 25-30.

- [3] Yu Meifei, & Chen Jing. (2019). *Research on the Impact of Venture Capital on Enterprise Growth—Based on the Perspective of Enterprise Ownership Nature and System Environment*. *Northern Finance Journal* (12), 26-36.
- [4] Park, K. , & Jang, S. C. . (2010). *Firm Growth Patterns: Examining the Associations with Firm Size and Internationalization*. *International Journal of Hospitality Management*, 29(3), 0-377.
- [5] Lv Qinghua, & Gong Shijie. (2016) *Research on the Evaluation of Sporting Goods Listed Companies Growth in China—Based on the Analysis of the Data from 2009 to 2013*. *China Sport Science* (1), 49-58.
- [6] Liu Chao, & Hu Baogui. (2018). *Research on Growth Evaluation of Listed Feed Companies Based on Factor Analysis*. *Chinese Journal of Animal Science*, 054(008), 125-130,136.
- [7] Ye Zongyu. (2003). *On the Selection of Index Normalization and Dimensionless Methods in Multi-index Comprehensive Evaluation*. *Statistical Theory and Practice* (04), 25-26.